United States Patent

[11] **3,577,624**

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[54] **CENTER FEED DRIVER ASSEMBLY**
11 Claims, 6 Drawing Figs.

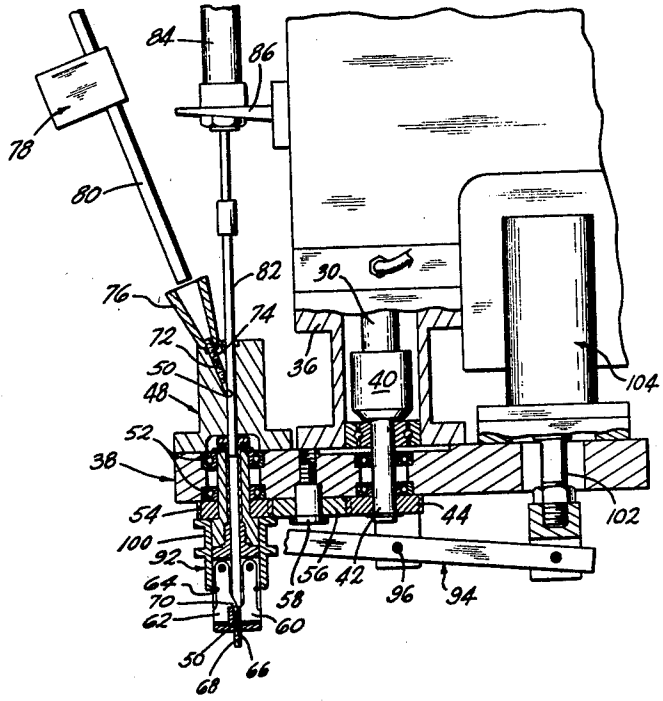
[52] **U.S. Cl.** **29/211,** 29/240.5
[51] **Int. Cl.** **B23q 7/10**
[50] **Field of Search** 29/211, 240, 240.5, 243

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ABSTRACT: Stud driving apparatus that includes a center feed driver which has a center bore into which studs can be fed singly, and a positioning rod which is movable in the bore relative to the driver for positioning the stud at one end of the driver. Spring actuated jaws are pivotally mounted in the driver for holding the first of the studs in a fixed position in the bore during the driving operation. The positioning rod is mounted relative to the driver so that when the latter moves toward the workpiece into which the stud is to be driven, the positioning rod will move relative to the driver to permit entry of a next stud into the bore for subsequent positioning by the positioning rod.



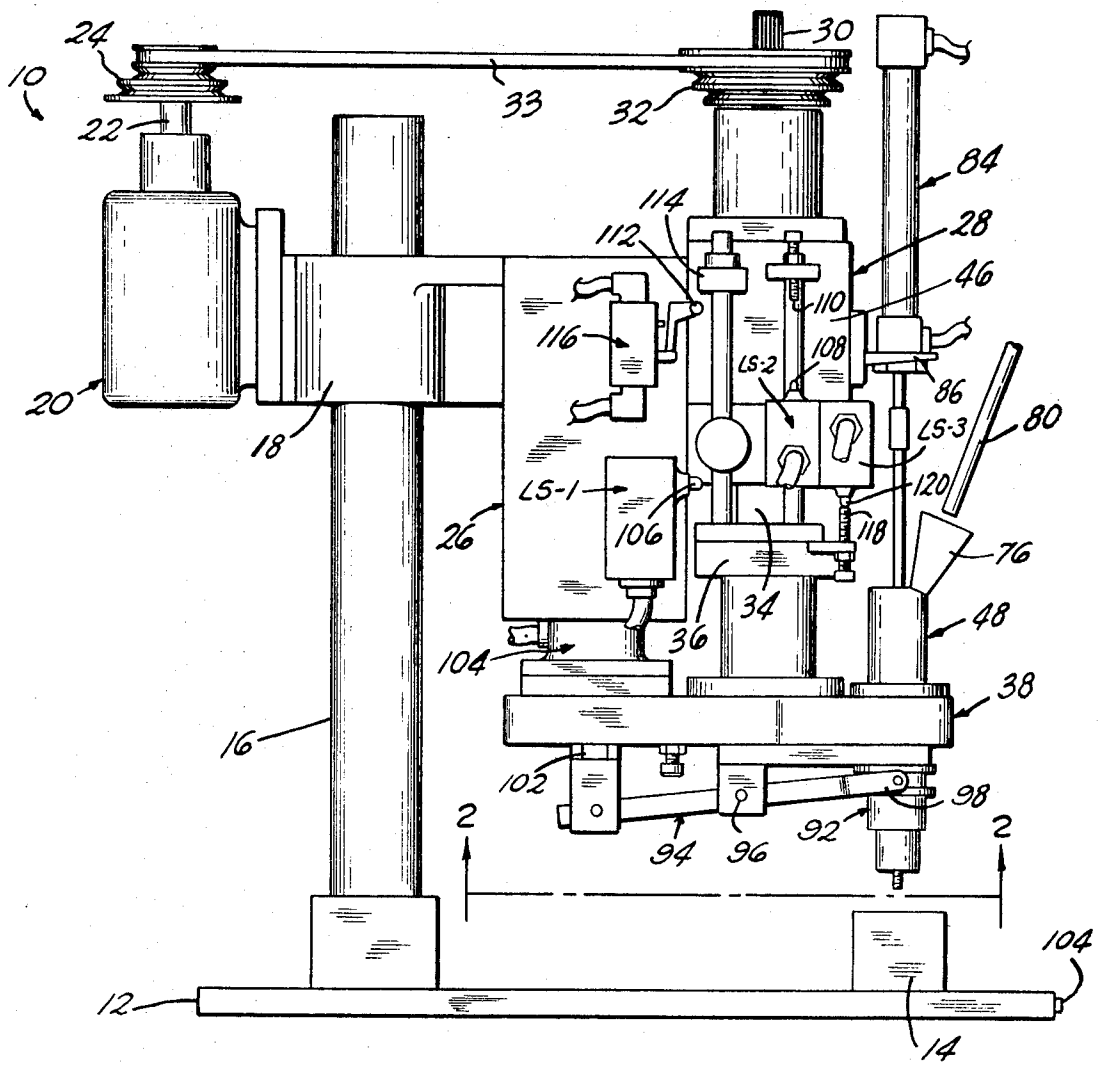


FIG. 1

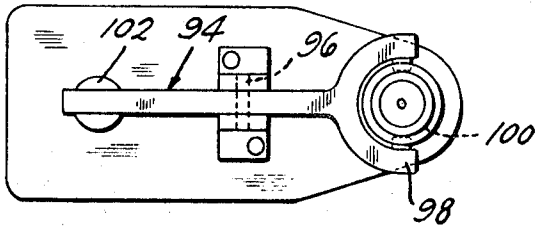


FIG. 2

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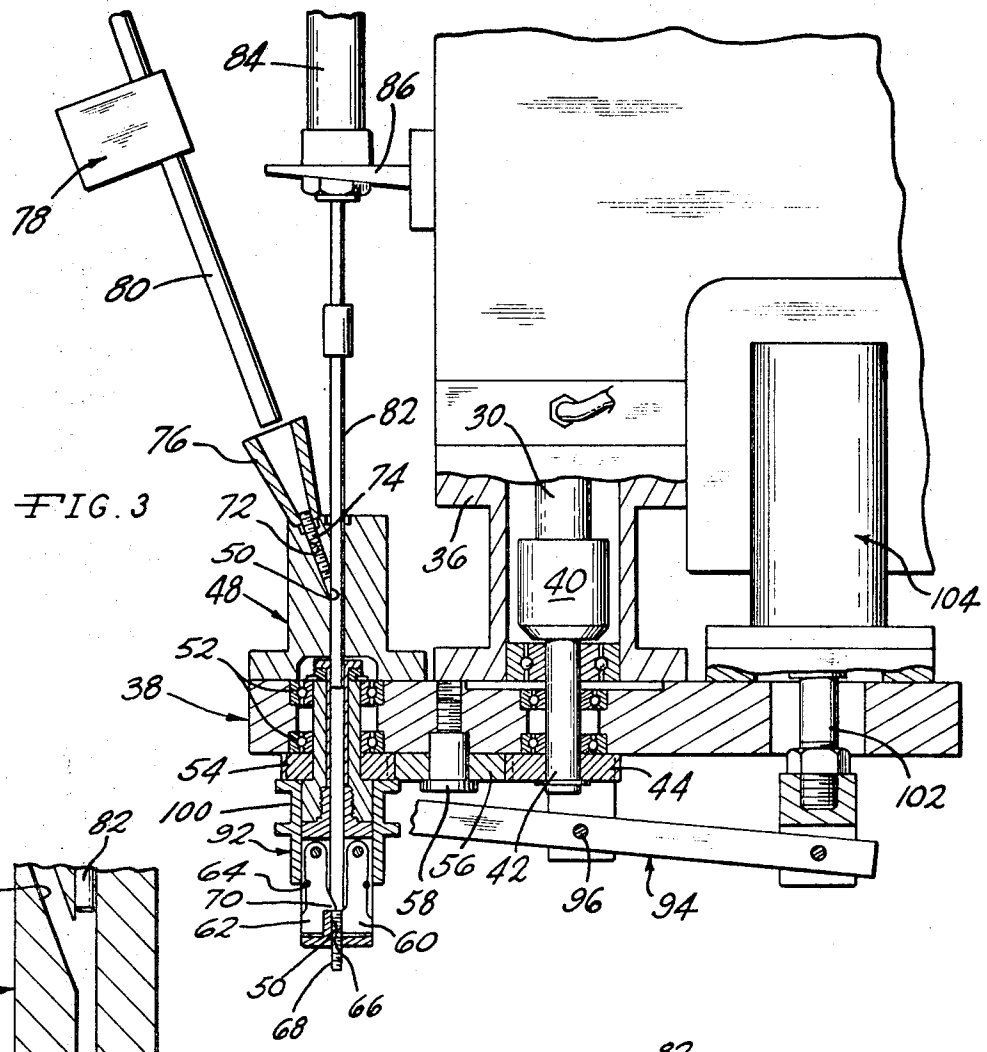


FIG. 3

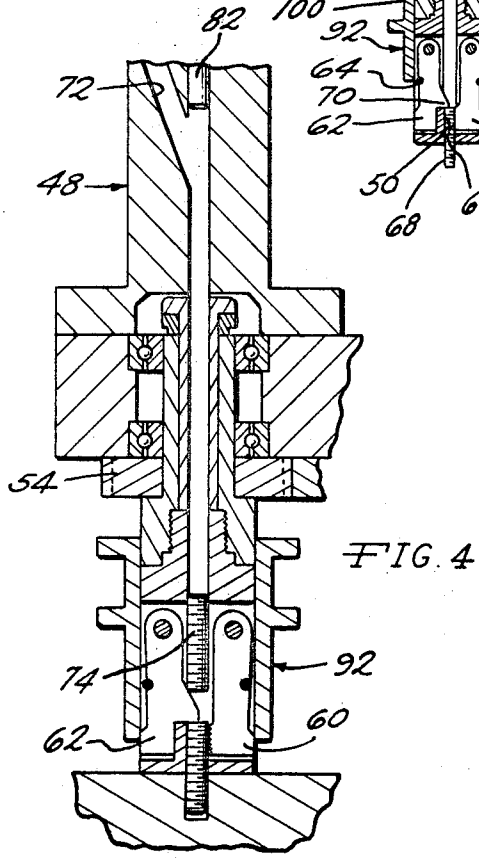


FIG. 4

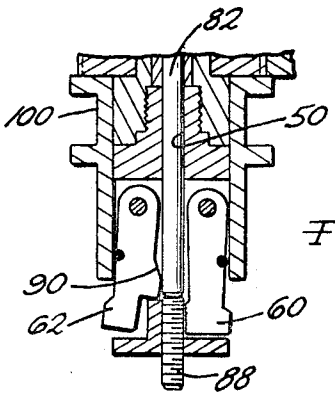


FIG. 5

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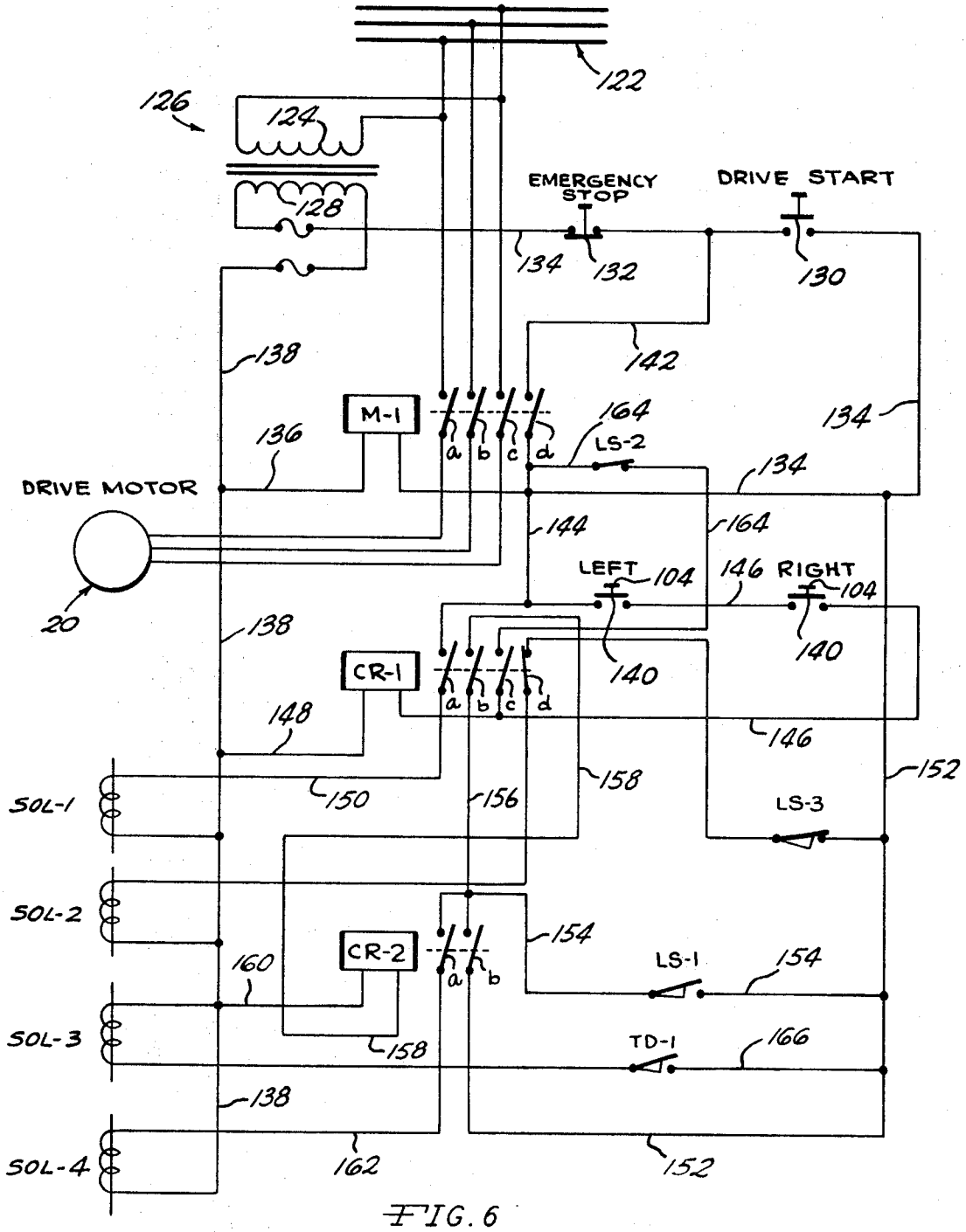


FIG. 6

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CENTER FEED DRIVER ASSEMBLY

BACKGROUND OF THE INVENTION

The present invention relates to machine tools for automatically driving threaded members, such as studs sequentially into a workpiece.

It is known to provide a power-operated driver for threaded members which includes a center bore in the driver into which a series of studs are fed. Arrangements such as this are disclosed, for example, in U.S. Pat. Nos. 3,034,547 and 3,034,548, issued May 15, 1962 to Cox, Jr., et al. In drivers of this character a series of studs is always present in the bore, and it is necessary to provide means to prevent the succeeding studs from interferring with the holding and driving of the first stud.

It is also known to provide a power-operated driver for feeding screws singly through a rotatable member, such as is shown in U.S. Pat. No. 2,878,700, issued Mar. 24, 1959 to Reynolds.

SUMMARY OF THE INVENTION

The present invention is directed to improvements over the prior art whereby threaded members, such as studs and the like, can be fed singly into the bore of a driver, and such stud will be positioned automatically for the driving operation, and wherein a succeeding stud is then positioned in the bore for subsequent positioning within optimum time limits without handling problems that can occur when a series of studs are retained simultaneously in the bore.

According to a preferred form of the present invention, a center feed driver assembly is provided for driving threaded studs which includes a rotatable driver having a center bore for receiving the threaded studs. Means are provided for moving the driver longitudinally between an advanced position and a retracted position, and a feeder means is provided which is responsive to the position of the driver for feeding a stud into one end of the bore corresponding to the retracted position of the driver. A gripper means is carried by the driver having a face for entering the bore at the other end thereof for gripping a first stud at a location with its end portion projecting beyond the other end of the bore. A positioning rod is movable longitudinally in the bore between a first position for positioning a stud at said location to be gripped by the gripper means and a second position at the other end of the bore blocking a second stud from entering the bore. Means are provided which are responsive to movement of the driver to its retracted position to move the positioning rod to its first position and after a time delay to return the positioning rod to its second position. Stop means are carried by the driver having an abutment for entering the bore to block the bore behind the first stud after return of the positioning rod to its second position, and lock means are operable to lock the gripper means and the stop means with their face and abutment in said bore, and such means is responsive to the driver reaching its advanced position to release the gripper means and the stop means. The positioning rod is supported independently of the driver so that when the driver moves toward its advanced position, relative movement will occur between the driver and the positioning rod to unblock the bore to allow the second stud to enter the bore.

Accordingly, it is an object of the present invention to provide an improved center feed driver assembly for feeding and driving threaded members such as studs and the like, into workpieces.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a center feed driver assembly embodying one form of the present invention showing the assembly in one stage of its operation;

FIG. 2 is a fragmentary bottom plan view taken on the line 2–2 of FIG. 1;

FIG. 3 is an enlarged fragmentary side elevational view, partly in section, taken from the other side of the illustrated embodiment of this invention;

FIG. 4 is an enlarged fragmentary section of the driver when in its advanced position after having driven a stud into a workpiece;

FIG. 5 is a fragmentary sectional view similar to that of FIG. 4, but showing the driver at a different stage of operation; and

FIG. 6 is a schematic diagram of the electrical circuit for the center feed driver assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring now to the drawings, the invention will be described in greater detail. The stud driver or center feed driver assembly **10** is shown on a base **12** on which a workpiece **14** is supported. Mounted on the base **12** is a column **16** which carries a mounting bracket **18**. A drive motor **20** is carried by the mounting bracket **18** and has a drive shaft **22** on which is mounted a drive pulley **24**. The mounting bracket **18** also carries a stationary support frame **26** on which is mounted an air motor or cylinder **28**.

The air cylinder **28** is a conventional type which includes the spindle **30** which is splined at its upper end on which the driven pulley **32** is mounted for axial or longitudinal movement and for turning the spindle **30** by virtue of the action of belt **33**. A piston (not shown) is connected to the quill **34** for imparting longitudinal movement thereto. The quill **34** is connected to the adapter **36** which in turn is connected to the head **38** for moving the latter between a retracted position shown in FIG. **1** and an advanced position shown in FIG. **4**. The spindle **30** is connected at its lower end to a spindle adapter **40** for turning the shaft **42** to which is keyed the drive spur gear **44**.

The stationary cylinder portion **46** of the air cylinder **28** is mounted on the stationary support frame **26**. Thus, it can be seen that the quill **34** can be rotated in response to turning of the drive motor **20**. Also, in response to movement of the piston (not shown) in the air cylinder **28**, the head **38** can be moved vertically between a retracted position and an advanced position.

Mounted on the head **38** for rotary movement is a driver **48** which has a center bore **50** extending therethrough. As can be seen best in FIG. **3**, the driver **48** is supported for rotation by the bearings **52**. Keyed to the driver **48** is a driven spur gear **54** which is drivingly connected to the drive gear **44** by the idler gear **56**. The latter gear is removable by means of the element **58**, as are the other gears **44** and **54** so that various drive ratios can be selected between the gear **44** and the gear **54**.

Mounted on the driver **48** for pivotal movement is a first jaw or gripper means **60** and a second jaw or stop means **62**. Suitable spring means such as the rubber O-ring **64** normally urges the jaws **60** and **62** radially inwardly so that the face **66** of jaw **60** is in gripping engagement with a first stud **68**, and the abutment **70** of the jaw **62** is in abutting engagement with the end of the stud **68** to act as a stop to prevent backward movement of the stud during driving action of the driver **48**. Normally, the jaw **60** will have a threaded face **66** adapted to fit into the threads of the stud **68**.

The driver **48** has an inlet duct **72** at its one end into which a second stud **74** can be fed into the bore **50**. For the purpose of feeding studs singly into the bore **50** of the driver **48**, a funnel member **76** is provided which is in communication with a stationary escapement mechanism **78** which is of a conventional

design for feeding studs singly through the feed duct 80 to the funnel 76, where such stud can assume the position shown by the stud 74, FIG. 3.

Extending into the one end of the bore 50 is a positioning rod 82 which is connected to the piston (not shown) of the air cylinder 84 which is mounted by means of the bracket 86 onto the stationary portion 46 of the air cylinder 28. By virtue of this construction and arrangement, the positioning rod 82 can be moved between a first position shown in FIG. 3 wherein it blocks the duct 72 so that the second stud 74 cannot enter the bore 50, and a second position wherein the positioning rod has advanced sufficiently far to move a stud 88 to a location with its end portion projecting beyond the end of the bore 50 where the threaded face of the jaw 60 can grip and retain the stud 88 in place. It will be noted that when the positioning rod 82 is in its second position, the jaw 62 which has an inclined face 90 has been deflected out of the path of the stud 88. As can be seen in FIG. 3, when the positioning rod 82 is returned to its first position, the jaw 62 will be spring biased into a position wherein its abutment 70 is positioned behind the stud 68 so that the latter is retained against axial movement back into the bore 50.

In order to assure that the stud to be driven into the workpiece does not rotate relative to the driver 48 during the driving operation, a sleeve 92 is carried on the driver 48 and is movable between the release position shown in FIG. 3 and the lock position shown in FIG. 4. When in the release position shown in FIG. 3, the jaws 60 and 62 can be moved out of the bore 50 in response to pushing action of the positioning rod 82 against a stud positioned in the bore 50 so that the stud will be located in the position illustrated in FIG. 5. When the sleeve 92 is moved longitudinally of the driver 48 to the position illustrated in FIG. 4, the jaws 60 and 62 are locked in place, thereby preventing movement axially or rotationally relative to the driver 48.

For the purpose of moving the sleeve 92 between its release position and its lock position, an actuator arm 94 is provided which is pivotally mounted on the fixed pin 96. The arm 94 has a trunnion mounting 98 at its one end by which the actuator arm 94 is connected to the sleeve 48 in the channel portion 100. The actuator arm 94 is connected to the rod 102 of the air cylinder 104 that is mounted on the head 38 for moving the sleeve between its locked position and its release position.

In the normal operation of the machine, it will initially be cycled so as to place a stud in the driver in the position shown in FIG. 3. The operator then presses two palm buttons 104 which closes a circuit, to be described, whereby the head 38 begins to move downwardly from its retracted position to its advanced position. After the head has traveled downwardly a short distance, the contact 106 of the limit switch LS–1 is engaged by the moving contact 107 actuating the air cylinder 104 so as to pivot the actuator arm 94 to move the sleeve 92 from its release position to its lock position shown in FIG. 4. The head continues its downward movement and drives the stud into the workpiece 14 in response to the rotary action of the driver caused by the drive motor 20. In this fully extended position the next stud, such as stud 74 illustrated in FIG. 3, drops into the bore 50, because when the driver has moved to its advanced position it has moved relative to the positioning rod 82 as can be seen in FIG. 4, so as to unblock the duct 72 permitting the stud 74 to drop to the position shown in FIG. 4.

When the driver 48 has reached its fully extended position, limit switch LS–2 is actuated as the result of its contact element 108 being engaged by the movable contact element 110. When this occurs air cylinder 28 is reversed in its operation causing the head 38 to move upwardly towards its retracted position. On the upward movement of head 38, the contact element 112 is engaged by the contact element 114 to actuate an air valve 116 which in turn actuates the positioning rod cylinder 84 to cause the positioning rod 82 to advance to the position shown in FIG. 5 where it again positions a stud at a location where it can be gripped by the gripping means 60, and upon retraction of the positioning rod 82 such stud can be held against axial displacement by the stop means 62.

A time delay device is associated with the air valve 116 to hold the positioning rod 82 in its fully extended position until the head 38 is fully retracted to assure that the next stud which is released by the escapement mechanism 78 will be blocked from entry into the bore 50 by the positioning rod 82. When head 38 is fully retracted, the movable contact 118 will engage the stationary contact element 120 of limit switch LS–3 to complete the cycle, and at the same time an associated time delay switch TD–1 will be closed to actuate the escapement mechanism 78 to deposit a stud in the duct 50 for a next succeeding cycle of operation.

From the above description it will be noted that the air valve 116 and the limit switches LS–1, LS–2, and LS–3 are mounted in a fixed position relative to the stationary head support frame 26 and the cylinder portion 46, and the movable contacts 107, 110, 114 and 118 are mounted for movement with the quill 34 of the air cylinder 28.

Referring now to FIG. 6, a brief description will be provided of the electrical control circuit for the center feed driver assembly. As is there shown, a source of high voltage power is provided at 122 to which the primary 124 of a transformer 126 is connected, the secondary 128 being in a circuit to provide a lower voltage to the various control circuits. Also driven from the power source 122 is the drive motor 20 which is controlled by the relay M-1.

When it is desired to energize the drive motor 20, the drive start switch 130 is closed, thereby closing a circuit through the secondary 128, normally closed emergency stop switch 132, drive start switch 130, conductor 134 which leads to relay M-1, conductor 136, and conductor 138 which is connected to the transformer secondary 128. Energizing the relay M-1 will cause normally open contacts M-1*a*, *b*, *c*, *d* to be closed thereby closing a circuit between the power source 122 and the drive motor 20. Closing of normally open contact M-1*d* will also provide a source of low voltage power to the control circuits for operating the stud driver or center feed driver assembly 10.

The control system includes the limit switches LS–1, LS–2, LS–3 and time delay switch TD–1, all previously described. Also included in the circuit are the solenoids SOL–1, SOL–2, SOL–3 and SOL–4. Solenoid SOL–1 is connected to the valve controls for air cylinder 28 so that when the solenoid is energized air cylinder 28 will be actuated to move head 38 downward toward its advanced position. Solenoid SOL–2 is also connected to the valve controls for air cylinder 28 so that when energized, the air cylinder 28 will be actuated to move head 38 upward toward its retracted position. Solenoid SOL–3 is connected to the escapement 78 so that when it is energized, escapement 78 will release one stud into the feed duct 80. Solenoid SOL–4 is connected to the valve controls for air cylinder 104 so that when it is energized, the actuator arm 94 will move sleeve 92 to its lock position and when deenergized sleeve 92 will be returned to its release position.

Also included in the circuits are the control relays CB–1 and CB–2 for controlling the operation of the several solenoids.

Assuming that the motor 20 has been energized and that the contact M-1*d* is in its closed position, the operation of the control circuit will now be described. Initially, the operator will press the left and right palm buttons 104 thereby closing the switches 140 which will result in a circuit being closed including the transformer secondary 128, conductor 134, emergency stop switch 132, conductor 142, contact M-1*d*, conductor 144, conductor 146 via closed contacts 140, relay CR–1, conductor 148 and conductor 138. The energizing of control relay CR–1 will cause normally open contacts CR-1*a*, *b*, *c* to close and normally closed contact CR-1*d* to open. Closing of contact CR-1*a* will complete a circuit including conductor 144 through contact CR-1*a* and conductor 150 to solenoid SOL–1, conductor 138, transformer secondary 128, conductors 134, and 142, thereby energizing solenoid SOL–1 to start the head 38 on its downward movement from its retracted position toward its advanced position. It will be noted that solenoid SOL–2 is necessarily deenergized at all times when solenoid SOL–1 is energized, because when the latter condi-

tion exists, the contact CR–1 in series with solenoid SOL–2 is open.

The manner in which the sleeve **92** is moved to its lock position and returned to its release position will now be explained. As was previously indicated, when control relay CR–1 is energized, the contact CR-1*b* is closed, thereby providing a closed circuit after limit switch LS–1 is contacted from transformer secondary **128**, conductors **134** and **142**, contact M-1*d*, conductors **144**, **134**, **152**, conductor **154** and normally open limit switch LS–1, which is momentarily closed after the head has made a short downward movement, conductor **156**, closed contact CR-1*b*, conductor **158**, control relay CR–2, conductor **160**, and conductor **138**. Energizing control relay CR–2 will close normally open contacts CR-2*a*, *b*, and closing of the latter contact will have the effect of locking the control relay CR–2 in its energized position after limit switch LS–1 has reopened. Thus, current will then flow from the conductor **152** through closed contact CR-2*b*, conductor **156**, contact CR-1*b*, conductor **158**, control relay **2**, and conductor **160**. In this manner, control relay CR–2 will function to keep solenoid SOL–4 energized until control relay CR–1 is deenergized due to the opening of limit switch LS–2 which in turn occurs when head **38** reaches its fully extended or advanced position. It is to be observed that solenoid SOL–4 will remain energized via conductors **152**, contacts CR-2*a*, *b* and conductors **162** and **138**. Control relay CR–2 will then be deenergized due to the opening of limit switch LS–2, which occurs when the head **38** reaches its fully extended or advanced position. Prior to opening limit switch LS–2, control relay CR–1 will be energized via conductor **164** which contains normally closed limit switch LS–2, contact CR-1*c*, conductor **146**, control relay CR–1 and conductor **148**.

The solenoid SOL–3 which controls the releasing of a stud from escapement **78** is normally deenergized, and is energized when time delay switch TD–1 is closed. This action occurs when the head **38** is fully retracted, by closing time delay switch TD–1 which is in conductor **166**, extending between conductor **152** and solenoid SOL–3. The time delay assures that the stud is released from the escapement **78** before the time delay switch TD–1 opens to deenergize solenoid SOL–4.

I claim:

1. A center feed driver assembly for threaded members comprising a rotatable driver having a center bore for receiving threaded members, feeder means for feeding threaded members singly into one end of said bore, gripper means carried by said driver having a face for entering the bore at the other end thereof for gripping a first member at a location with its end portion projecting beyond the other end of the bore, a positioning rod longitudinally movable to a first position in said bore for positioning a member in said bore at said location to be gripped by said gripper means, stop means carried by said driver having an abutment for entering the bore to block the bore behind said first member, said positioning rod blocking said bore at said one end thereof when in its first position to prevent entry of a second member into said bore, and means for producing relative movement between said driver and said positioning rod so that the latter is moved to a position to unblock said bore whereby a second member from said feeder means can be released into said bore.

2. A center feed driver assembly as is defined in claim **1**, wherein said feeder means includes an escapement mechanism for releasing a threaded member prior to the occurrence of the relative movement of the positioning rod to unblock the bore.

3. A center feed driver assembly as is defined in claim **1**, wherein said gripper means and said stop means are pivotally mounted on said driver to permit entry of said face and said abutment into said bore.

4. A center feed driver assembly as is defined in claim **1**, wherein spring means urge said gripper means and said stop means into said bore.

5. A center feed driver assembly as is defined in claim **1**, wherein said gripper means and said stop means have inclined portions, engageable by a member advancing through said bore for urging said gripper means and said stop means out of said bore.

6. A center feed driver assembly as is defined in claim **1**, wherein a sleeve is mounted on said driver for longitudinal movement between a lock position in which said gripper means and said stop means are held with said face and said abutment in said bore and a release position in which said gripper means and said stop means can be moved out of said bore.

7. A center feed driver assembly as is defined in claim **6**, wherein a sleeve actuating mechanism is coupled to said sleeve for moving the latter between its lock position and its release position and control means are provided for said actuating mechanism for moving said sleeve to its lock position after said positioning rod has moved to its first position.

8. A center feed driver assembly as is defined in claim **1**, wherein said means for producing relative movement between said driver and said positioning rod comprises first means for moving said positioning rod from said first position to a second position longitudinally spaced from said first position so that said abutment can enter said bore, and second means for advancing said driver independently of said positioning rod in the direction that the end portion of the first member projects.

9. A center feed driver assembly for threaded members comprising a rotatable driver having a center bore for receiving threaded members, feeder means for feeding threaded members singly into one end of said bore, gripper means carried by said driver having a face for entering the bore at the other end thereof for gripping a first member at a location with its end portion projecting beyond the other end of the bore, a positioning rod longitudinally movable to a first position in said bore for positioning a member in said bore at said location to be gripped by said gripper means, stop means carried by said driver having an abutment for entering the bore to block the bore behind said first member, means for moving said positioning rod from said first position to a second position longitudinally spaced from said first position so that said abutment can enter said bore, said positioning rod blocking said bore at said one end thereof when in its second position, and means for moving said driver longitudinally relative to said positioning rod for driving said first member into a workpiece, said positioning rod being moved thereby relative to its second position to release a second member from said feeder means into said bore.

10. A center feed driver as is defined in claim **9**, wherein a lock mechanism is associated with said gripper means and said stop means for locking said gripper means and said stop means in place when their face and abutment are in said bore and for releasing said gripper means and said stop means in advance of said positioning rod moving to said first position.

11. A center feed driver assembly for threaded members comprising a rotatable driver having a center bore for receiving threaded members, means for moving said driver longitudinally between an advanced position and a retracted position, feeder means responsive to said driver being in its advanced position for feeding a threaded member into the one end of said bore corresponding to the retracted position of the driver, gripper means carried by said driver having a face for entering said bore at the other end thereof for gripping a first threaded member at a location with its end portion projecting beyond the other end of the bore, a positioning rod longitudinally movable between a first position in said bore for positioning a member at said location to be gripped by said gripper means and a second position at the one end of the bore blocking a second member from entering said bore, means responsive to movement of said driver to its retracted position to move said positioning rod to its first position and after a time delay to return the positioning rod to its second position, stop means carried by said driver having an abutment for entering the bore to block the bore behind said first member after return of said positioning rod to its second position, lock means operable to lock said gripper means and said stop means with their

face and abutment in said bore and responsive to said driver reaching its advanced position to release said gripper means and said stop means, said positioning rod being supported independently of said driver so that when said driver moves toward its advanced position relative movement will occur between said driver and said positioning rod to unblock the bore to allow the second member to enter said bore.